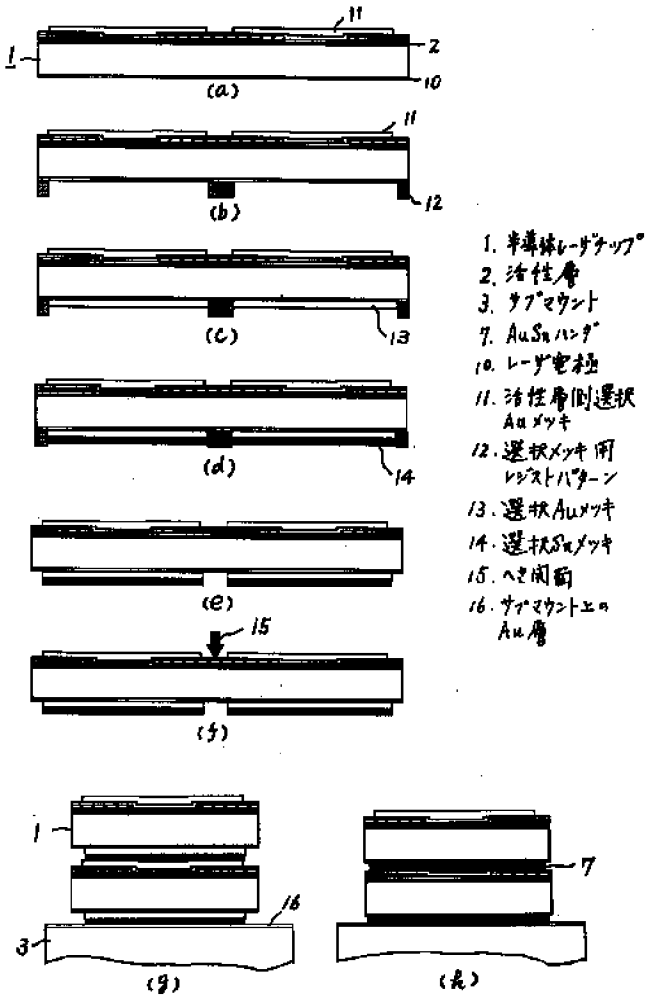
JAPANESE [JP,08-250804,A]

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to the manufacturing method of a semiconductor laser device, especially an assembly method.
[0002]
[Description of the Prior Art]In recent years, the semiconductor laser device is asked for a high increase in power. Generally as a manufacturing method for obtaining a high power semiconductor laser device, the J-down assembly and the stack assembly are adopted. In order to improve heat dissipation, a J-down assembly turns the active layer side (Junction side) down (down), and carries out ** arrival to submount with AuSn solder. A stack assembly is the method of accumulating a semiconductor laser device on a lengthwise direction. A J-down assembly method is shown

Drawing selection Representative draw



[Translation done.]

in drawing 4-a. In a figure, it is the Au layer by which forms in submount the active layer to which 1 emits a semiconductor laser chip and 2 emits light, and 3, 4 was formed in the AuSn solder pellet, and 5 was formed on submount. Drawing 4-b shows the problem in the conventional J-down assembly method. In a figure, 6 is a surroundings lump of AuSn solder. Since there is only a several micrometers interval of the active layer 2 and the submount 3 in the case of a J-down assembly, when control of the quantity of the AuSn solder pellet 4 is difficult and there is much quantity, the surroundings lump 6 occurs, the active layer 2 is covered and the poor assembly of interrupting light occurs.

[0003]The conventional stack assembly method is shown in drawing 5. In a figure, although 7 is AuSn solder and ** arrival of between the submounts 3 is carried out to the semiconductor laser chip 1 with the AuSn solder 7, when there are many amounts of AuSn solder, the flash of AuSn solder, the angle gap between semiconductor laser chips, etc. arise like a J-down assembly. A soldering material is formed by the manufacturing stage of a semiconductor laser device, and there is also a method of performing an assembly. Drawing 6 is an example shown in JP,6-7628,A. In a figure, the AuSn solder in which 7 was formed by the manufacturing stage of the semiconductor laser device, the Sn layer in which 8 was formed by the manufacturing stage of the semiconductor laser device, and 9 are the Sn layers formed on submount.

In this method, the composition control of an AuSn alloy layer is difficult, and may not dissolve at the time of an assembly, but may become poor [an assembly]. Since a semiconductor laser device is cut down according to a cleavage, the defect at the time of a cleavage may generate it by the AuSn solder 7 and Sn layer 8 which are formed by micron order.

[0004]

[Problem(s) to be Solved by the Invention]As mentioned above, in the assembly method of the conventional semiconductor laser device, there was a problem that control of the amount of AuSn solder was difficult, and the angle gap between the flash of AuSn solder and the semiconductor laser chip at the time of a stack assembly, etc. arose. The soldering material was formed by the manufacturing stage of the semiconductor laser device, and there was a problem that control of the composition ratio of an AuSn alloy layer

was difficult, and the defect at the time of a cleavage occurred further, in the method of performing an assembly.
[0005]This invention was made in order to cancel the above problems, it enables control of the amount of AuSn solder, and prevents the flash of the AuSn solder at the time of an assembly, and generating of an angle gap etc., and an object of an invention is to provide the manufacturing method of the semiconductor laser device which poor HE **** does not generate further.
[0006]
[Means for Solving the Problem]A manufacturing method of a semiconductor laser device concerning this invention forms a resist pattern in a cleavage part on a laser electrode, equips a field except a HE **** part with a process of plating a Sn layer selectively, and performs a stack assembly. A process of plating a Sn layer selectively on the active layer side laser electrode, It has a process of dissolving a process of turning the active layer side of a semiconductor laser chip down, and loading it on a field in which an Au layer of submount was formed, submount and an Au layer which intervenes between the above-mentioned semiconductor laser chips, and a Sn layer, and forming an AuSn alloy layer, and a J-down assembly is performed. An Au layer is selectively plated in a lower layer of a Sn layer. After forming an Au layer in the upper layer of a Sn layer by unelectrolyzed substitution type plating, an Au layer is further formed in the upper layer of this Au layer in electrolytic plating.
[0007]
[Function]In the manufacturing method of the semiconductor laser device in this invention. Since a Sn layer is selectively plated to the field except a cleavage part, a poor cleavage does not occur, By furthermore controlling the thickness of a Sn layer and each Au layer, the quantity of an AuSn alloy can be optimized and the flash for the surplus of an AuSn alloy and the laminated angle gap of a semiconductor laser chip can be prevented. Since a Sn layer and an Au layer are formed by a monolayer, respectively, the AuSn alloy whose presentation was stable can form certainly, By furthermore controlling the thickness of a Sn layer and each Au layer, the quantity of an AuSn alloy can be optimized, the surroundings lump to the active layer for the surplus of an AuSn alloy can be prevented, and a J-down assembly can be performed with the sufficient yield. By plating an Au layer selectively in the lower layer of a Sn layer, it becomes the composition that the Sn layer was

inserted into the Au layer, and alloying can still be ensured. According to unelectrolyzed substitution type plating, the adhesion force to a Sn layer is strong, by forming an Au layer in electrolytic plating further, the Au membrane which does not separate easily can be formed, oxidation of a Sn layer and etching with resist removing liquid can be prevented, and stabilization of a presentation of an AuSn alloy is attained.

[0008]

[Example]

Below example 1. describes one example of this invention about a figure. Drawing 1 is a figure in the manufacturing method of the semiconductor laser device of this invention showing the flow to a stack assembly. In a figure, 10 is a laser electrode and an arrow with which in 11 as for active layer side selection Au plating and 12 the resist pattern for selective plating and 13 show selection Au plating, 14 shows selection Sn plating, and 15 shows the direction of a cleavage, and 16 is an Au layer on submount. A same sign is attached about a conventional example, identical parts, and an identical material, and explanation is omitted.

[0009]An assembly method is explained about a figure. First, the laser electrode 10 is formed in the semiconductor laser chip 1 in front of the cleavage by which the selection Au plating 11 is formed at 2 micrometers in thickness on the field by the side of an active layer (drawing 1 - a). Next, the resist pattern 12 for selective plating is formed, and formation of plating to a cleavage portion is prevented (drawing 1 - b). The selection Au plating 13 is formed there at 1 micrometer in thickness (drawing 1 - c), and the selection Sn plating 14 is formed at 2 micrometers in thickness on it (drawing 1 - d). Then, the resist pattern 12 for selective plating is removed (drawing 1 - e), and a cleavage separates into each semiconductor laser chip 1 from the direction of the arrow 15 (drawing 1 - f). furthermore -- laying what accumulated the two above-mentioned semiconductor laser chips 1 (drawing 1 - g) on the submount 3 in which 2-micrometer-thick Au layer 16 is formed -- time processing predetermined in the inside of 340 ** atmosphere, if it carries out, Au and Sn alloy and Au: Sn=8:2wt% of the AuSn solder 7 is formed (drawing 1 - h).

[0010]Since Au and Sn are formed by a monolayer, respectively according to this example, by controlling each thickness, the arbitrary presentations of AuSn solder are acquired and it can alloy certainly. Since the amount of

AuSn solder is easily controllable by changing the plating film thickness of an Au layer and each Sn layer, and the area of a resist pattern, it can prevent the flash of AuSn solder, and the angle gap at the time of a stack assembly. Since a cleavage part is avoided, selective plating is performed and an AuSn soldering material is formed, it does not become the cause that a cleavage is poor. From the above thing, according to the manufacturing method of this example, the stack assembly of a semiconductor laser device can be performed easily, and it is effective in raising the yield.

[0011]In the example 2. example 1, since the selection Sn plating 14 is shown in the outermost surface of a semiconductor laser chip, it turns out that about 0.3 micrometer of Sn is etched with the release liquid for removing the resist pattern 12 for selective plating. Since Sn oxidizes easily, it forms the Au layer for protecting Sn on the Sn plating 14 in this example. Drawing 2 is a figure showing the flow which forms an Au layer after the selection Sn plating 14 formed in Example 1. In a figure, 17 is unelectrolyzed replaced type Au plating.

[0012]The manufacturing method of the semiconductor laser device by this example is explained about a figure. First, according to the flow of Example 1, the unelectrolyzed substitution type Au plating 17 is formed in the semiconductor laser chip 1 (drawing 2 - a) in which the 1-micrometer-thick selection Au plating 13 and the 2.7-micrometer-thick selection Sn plating 14 were formed (drawing 2 - b). Replaced type plating is plating which Au melts Sn rather than is plated by Sn outermost surface, and Au replaces after that. In the Sn layer in which the surface oxidized, in the usual electrolytic plating, since the adhesion force between Sn and Au separates easily weakly, it becomes an unstable process, but according to the above-mentioned unelectrolyzed substitution type Au plating, the adhesion force between Sn and Au is powerful, and can attain stabilization of a process. The replaced type Au plating 17 is about 0.1 micrometer in thickness.

Since it is very thin, and will corrode to Sn of a ground and will discolor if it is neglected for a long time, the 1-micrometer-thick electrolysis Au plating 13 is further formed on the replaced type Au plating 17 (drawing 2 - c). Then, resist removing liquid removes the resist pattern 12 (drawing 2 - d). Since the Sn plating 14 is protected by the Au plating 13 at this time, it is not etched into resist removing liquid. Since according to this example Au plating

is formed on Sn plating, Sn is protected from etching with oxidation or resist removing liquid and loss of weight of Sn can be prevented, The relative value of the amount of Au plating and the amount of Sn plating can be maintained, stabilization of the presentation as AuSn solder can be attained, and a poor assembly can be reduced.

[0013]The J-down assembly flow which applied the AuSn solder structure in this invention is shown in example 3. drawing 3. In a figure, 18 is the active layer side laser electrode. The manufacturing method of the semiconductor laser device by this example is explained about a figure. On the active layer side laser electrode 18, like Example 2, the 2-micrometer-thick selection Sn plating 14, the unelectrolyzed Au plating 17, and the 2-micrometer-thick selection Au plating 13 are formed, and a cleavage separates into each chip after removing a resist pattern with the resist pattern for selective plating (drawing 3 - a). Next, the active layer 2 side is carried on the submount 3 in which 1-micrometer-thick Au layer 16 is formed (drawing 3 - b). Time processing, then predetermined Au and Sn alloy this in 340 ** atmosphere, and it becomes the AuSn solder 7. Au metal skin is total 3micrometer, a Sn plated layer is 2 micrometers, and Au=80wt% of AuSn solder is formed.

[0014]Since according to this example an AuSn soldering face product can be controlled at the time of the resist pattern formation for selective plating and the amount of AuSn solder can be further controlled also by plating film thickness, By optimizing each, a surroundings lump of solder can be prevented and the yield of a J-down assembly can be raised.

[0015]

[Effect of the Invention]As mentioned above, in this invention, the cleavage part of a semiconductor laser device is avoided, selective plating of Au and Sn is performed, and an AuSn soldering material is formed.

Therefore, a poor cleavage does not occur, but a stack assembly can be performed easily, and it is effective in raising the yield.

Since the amount of AuSn solder is controllable by selective plating, a surroundings lump of the solder to an active layer can be prevented, and the yield of a J-down assembly can be raised. Since unelectrolyzed substitution type Au plating is formed on Sn plating and Sn is protected from etching with oxidation or resist removing liquid, stabilization of the presentation as AuSn solder can be attained and a poor assembly can be reduced.

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